



EPA Tools & Resources Webinar: Smoke Sense – *A Citizen (Social) Science Approach to Inform and Improve Public Health Related to Wildfire Smoke Exposure*

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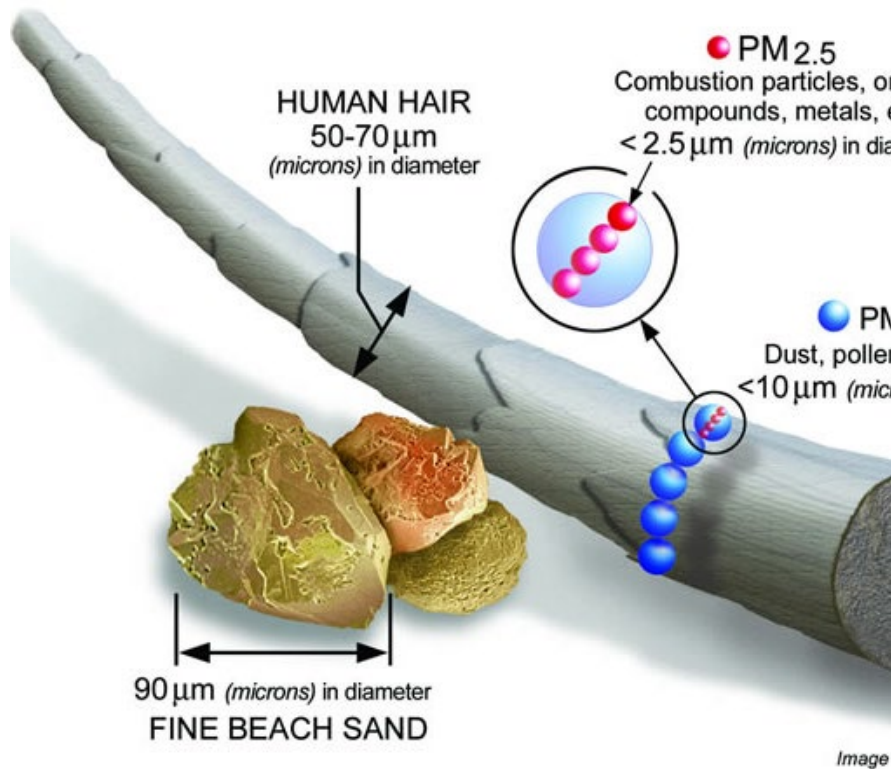
September 15, 2021



Can You See The Problem?



Fine Particulate Matter (PM_{2.5}) Health Effects



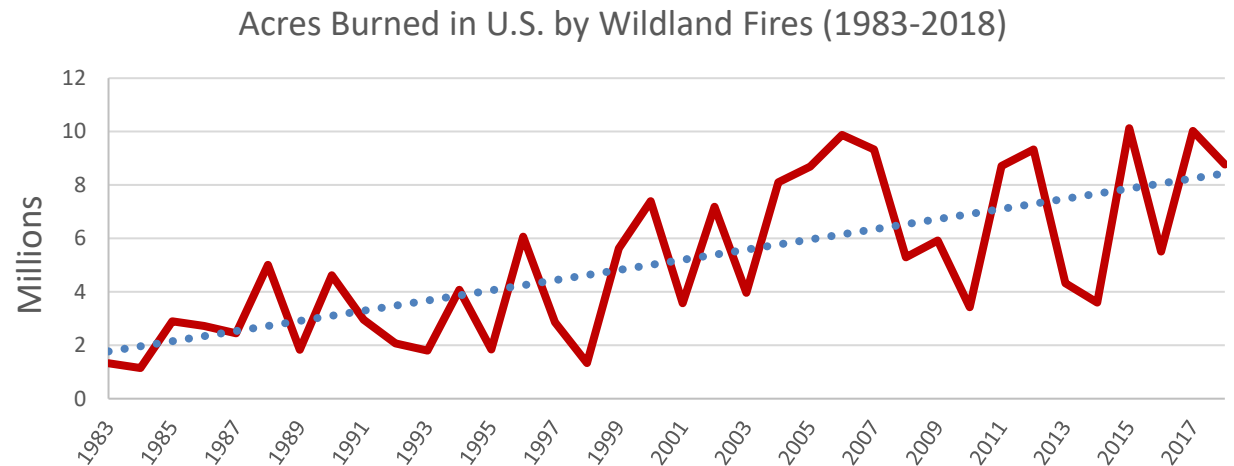
- Particle pollution, also called particulate matter or PM, is a complex mixture of extremely small particles and liquid droplets in the air
- Exposure to PM is linked to a variety of significant health problems, including:
 - Premature death in people with heart or lung disease
 - Aggravated asthma
 - Increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing

Wildfire Smoke is an Increasing Public Health Hazard in the US

The Problem:

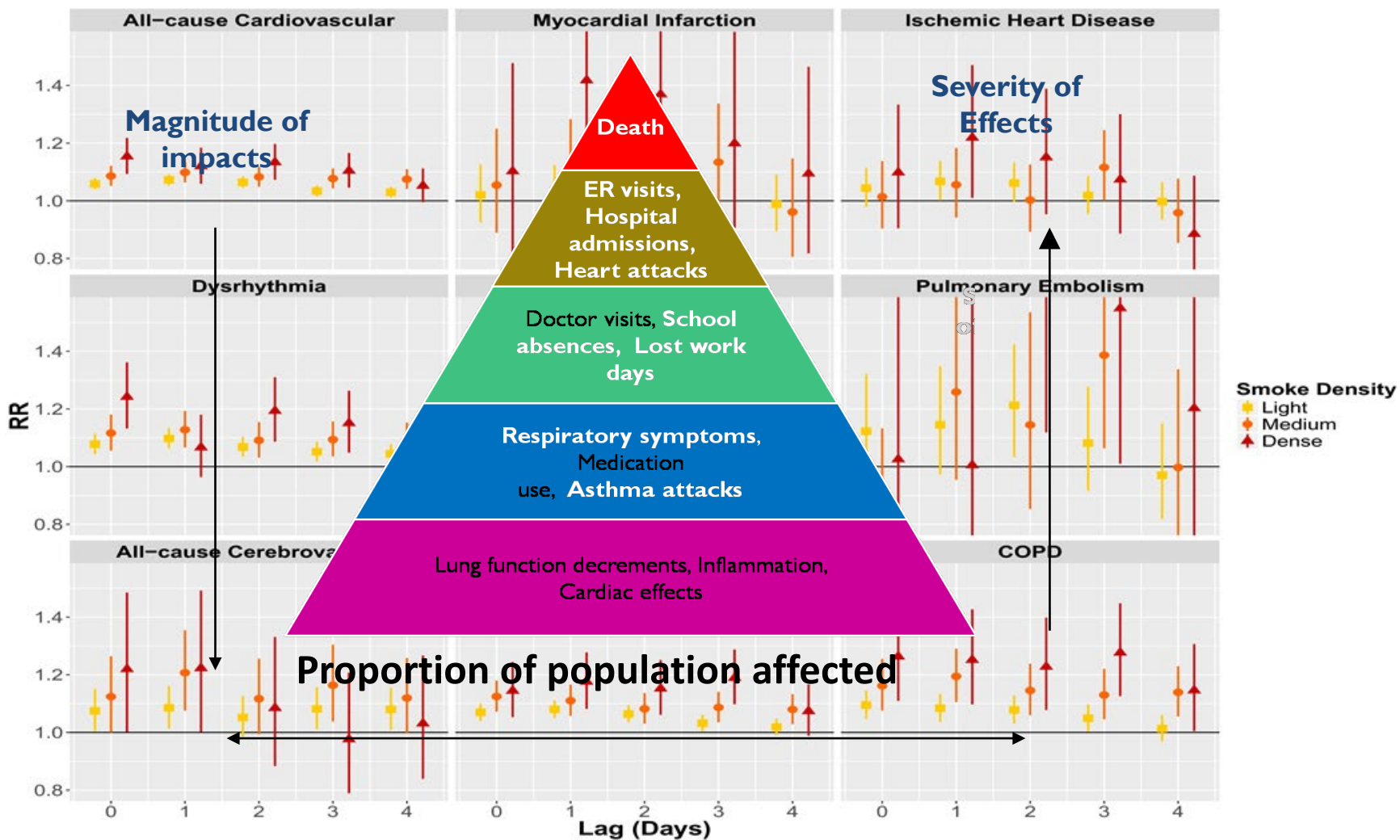
- Increasing acreage burned and intensity of wildland fires
- Increasing impact on urban areas
 - 10% of all land with housing situated in the wildland-urban interface
 - 38.5% of US housing units
- Increasing vulnerability of sensitive populations

(Radeloff et al. 2005)



Linear trend line shown in blue. Data from https://www.nifc.gov/fireInfo/fireInfo_stats_totalFires.html.

Relative Risk of Emergency Visits By Days And Smoke Density (California, 2015)



Wettstein, Hoshiko, Fahimi, Harrison, Cascio & Rappold, 2018

Cardio- and Cerebrovascular Emergency Department Visits Associated With Wildfire Smoke Exposure in California in 2015

Health Risk Communication is Central to Improved Health Outcomes

The role of Health Risk Communication is to motivate specific behaviors. In the case of wildfires, the desired behaviors include specific **actions** that reduce exposure:

- Wear a respirator mask
- Buy and use HEPA filters at work and home
- Respond in timely manner to the health recommendations
- Control the sources of indoor air pollution
- Reduce time outdoors

Some examples of ***known challenges to health risk communication***:

- Effects are varied and distributed across healthy and susceptible populations
- Severity of the effects varies as well, time to effect varies
- Environmental conditions may change rapidly
- You want to review a broad suite of behavioral responses then choose an appropriate behavior based on the assessment under rapidly changing conditions

BIG ASK!

Health Risk Communication seeks to overcome these challenges

Why is it so hard?

- Sunk cost
- Inertia
- We ascribe greater value to present benefits (present bias)
- Future benefits are uncertain
- We are not good at estimating risks
- Old habits are hard to break
- New habits are hard to start
- Optimism
- Above the average bias...



<https://medium.com/behavior-design/hyperbolic-discounting-aefb7acec46e>

Habits: Putting Retirement Savings/Actions on Auto-Pilot

Actions and Us

- Taking **action** requires **decision making**.
- Decision making should be based on facts and be objective unaffected by costs and benefits, our interpretation of evidence, preferences, contexts or values.
- Almost all **decisions** require some degree of personal **evaluation** of information, efforts and consequences.
- At the personal level, making unbiased evaluation of information is difficult and complicated by nonbinary choices, lack of evidence on salience of different decisions (how do we compare cost and benefit), lack of experience, lack of control over the environment, etc.
- Evidence may not be accessible immediately for everyone. For some factors we don't have objective evidence.
- One way to make evidence and salience more accessible is to form habits.

Smoke Sense Citizen Science Initiative Story

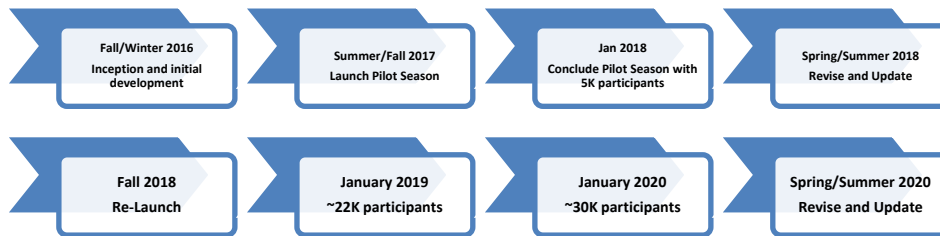
Objectives

- Understand the gap between what we know about risk and ways to protect our health and the observed public health outcomes
- Increase issue engagement
- Contribute to evidence-base related to the effectiveness of health risk messaging and communication strategies

Methods

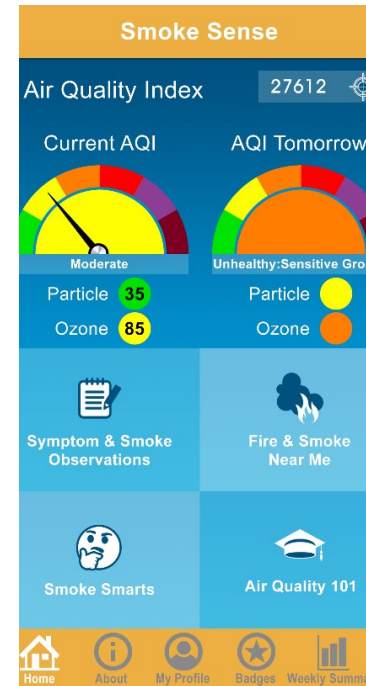
- Central component is [mobile app](#); also additional projects that support overall objectives

Timeline



The 2021 version combines Smoke Smarts and Air Quality 101 into “Quiz Corner.”

A new “What Can I Do?” module provides information about protecting your health.



Smoke Sense: Citizen Science in the Palm Of Your Hand



Who can participate:

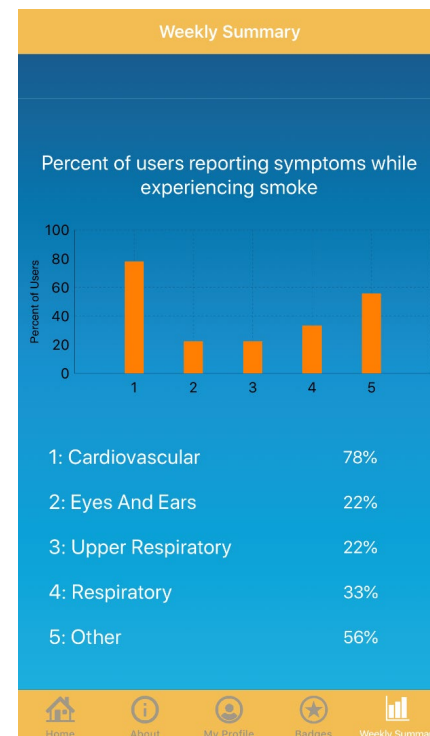
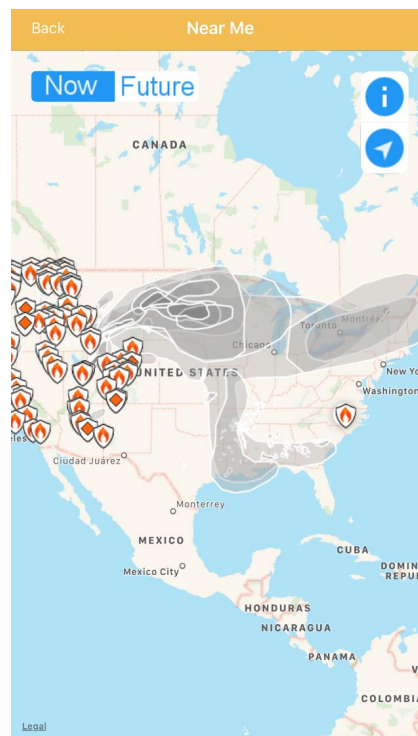
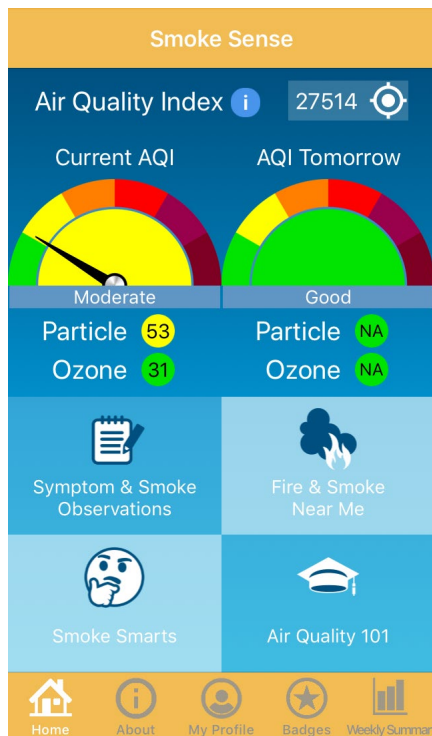
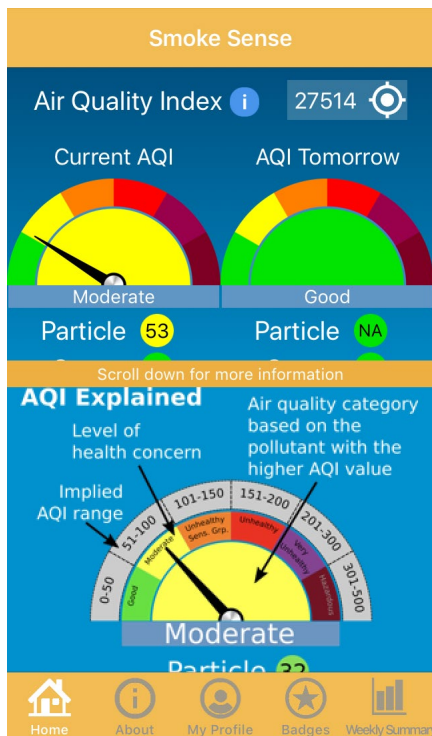
- Smartphone users
- Interested in smoke pollution and health
- Want to contribute to understanding health impacts

Participants can:

Learn → Interact → Contribute to Understanding

Iterative process to improve messages, behaviors, health outcomes


Smoke Sense App: 50K users in all 50 states




www.epa.gov/air-research/smoke-sense-study-citizen-science-project-using-mobile-app

Smoke Sense: What You Learn

Smoke Sense

Air Quality Index 27612 

Current AQI

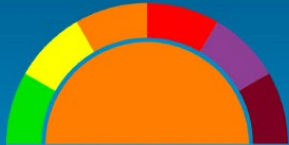


Moderate

Particle 35

Ozone 85

AQI Tomorrow








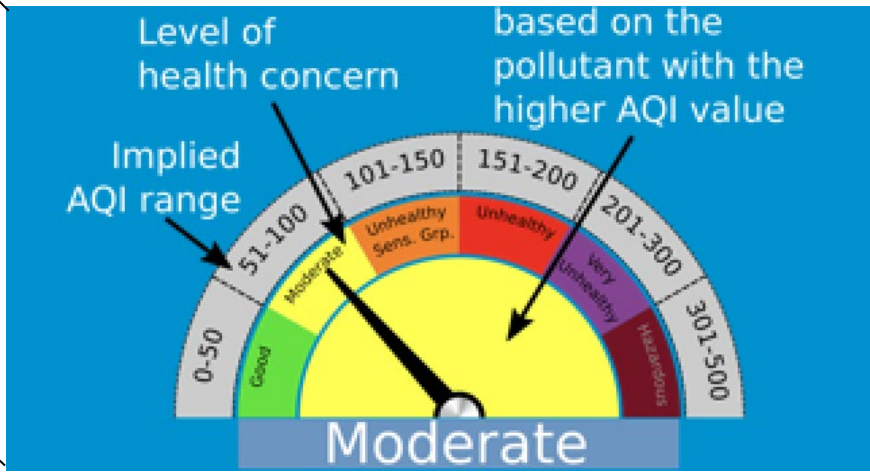
Unhealthy: Sensitive Groups

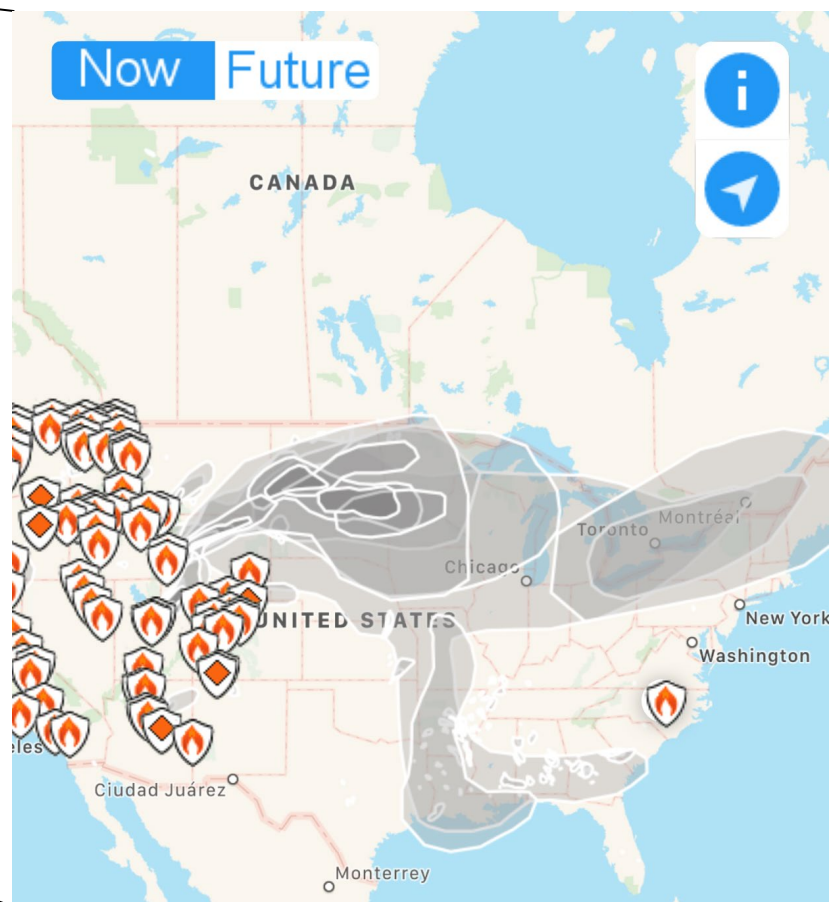
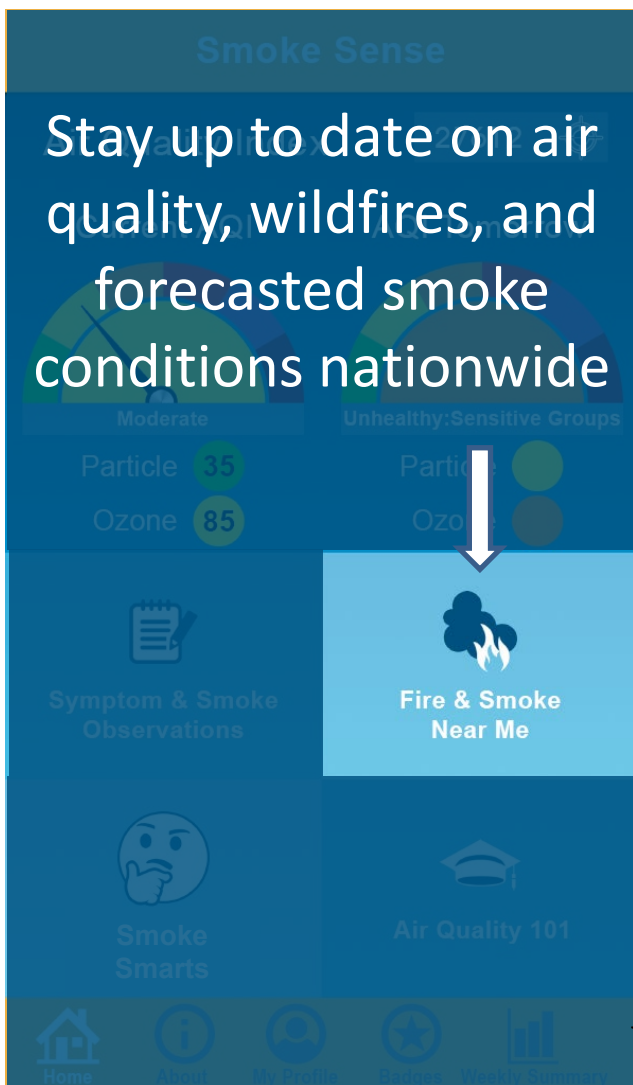
Particle ●

Ozone ●

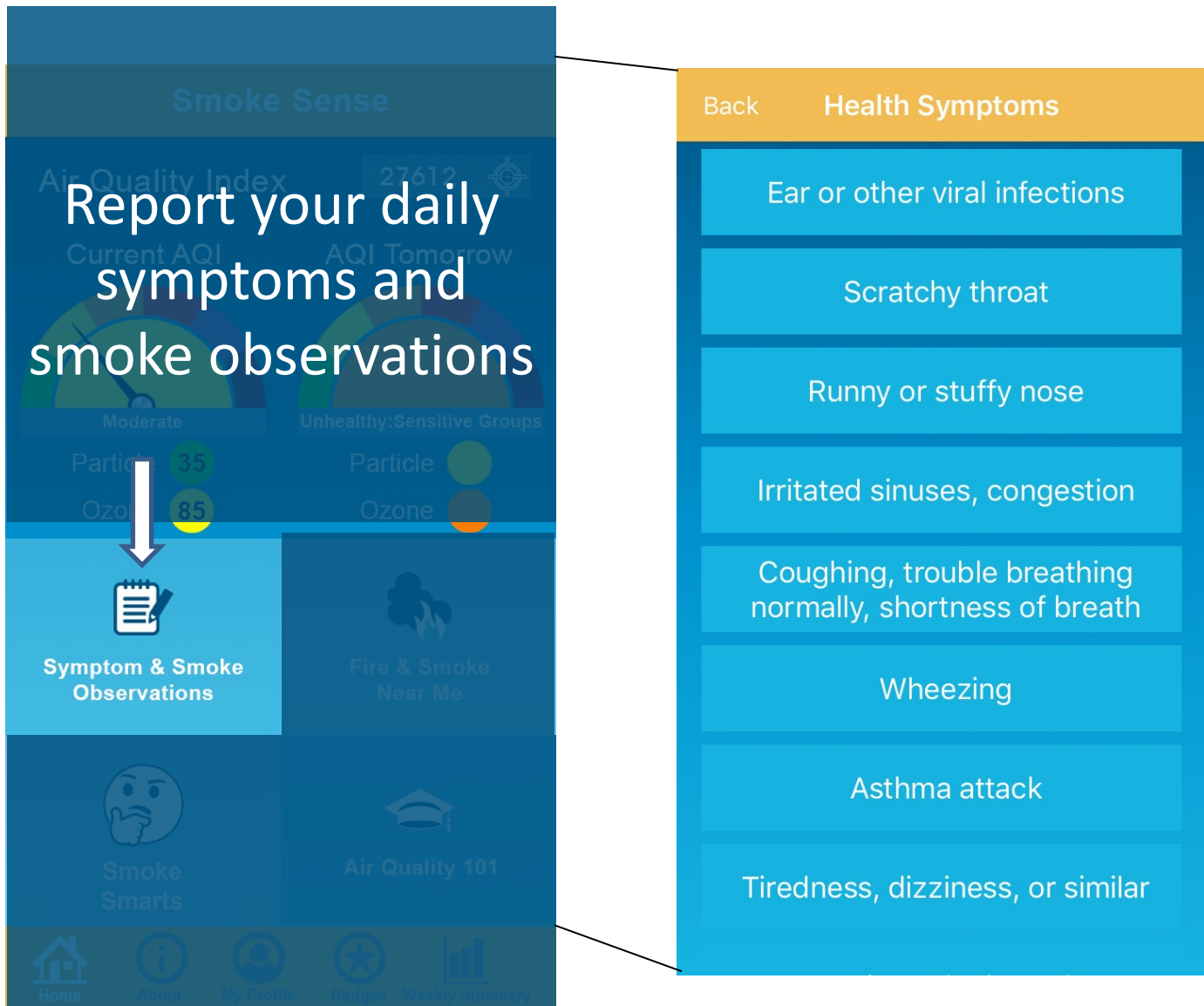
Check your air
Tap the screen to
learn more about
the Air Quality
Index





Smoke Sense: What You Contribute



The image shows a screenshot of the Smoke Sense mobile application. The main screen displays the title "Smoke Sense" at the top, followed by "Air Quality Index" and "27612". Below this, it shows "Current AQI" and "AQI Tomorrow" with corresponding gauges. The gauges indicate "Moderate" for Particles (35) and "Unhealthy: Sensitive Groups" for Ozone (85). A white arrow points from the "Symptom & Smoke Observations" button to a callout menu. The callout menu has a yellow header with "Back" and "Health Symptoms". It lists the following symptoms: "Ear or other viral infections", "Scratchy throat", "Runny or stuffy nose", "Irritated sinuses, congestion", "Coughing, trouble breathing normally, shortness of breath", "Wheezing", "Asthma attack", and "Tiredness, dizziness, or similar".

Smoke Sense

Air Quality Index 27612

Current AQI AQI Tomorrow

Moderate Unhealthy: Sensitive Groups

Particles 35 Ozone 85

Symptom & Smoke Observations

Fire & Smoke Near Me

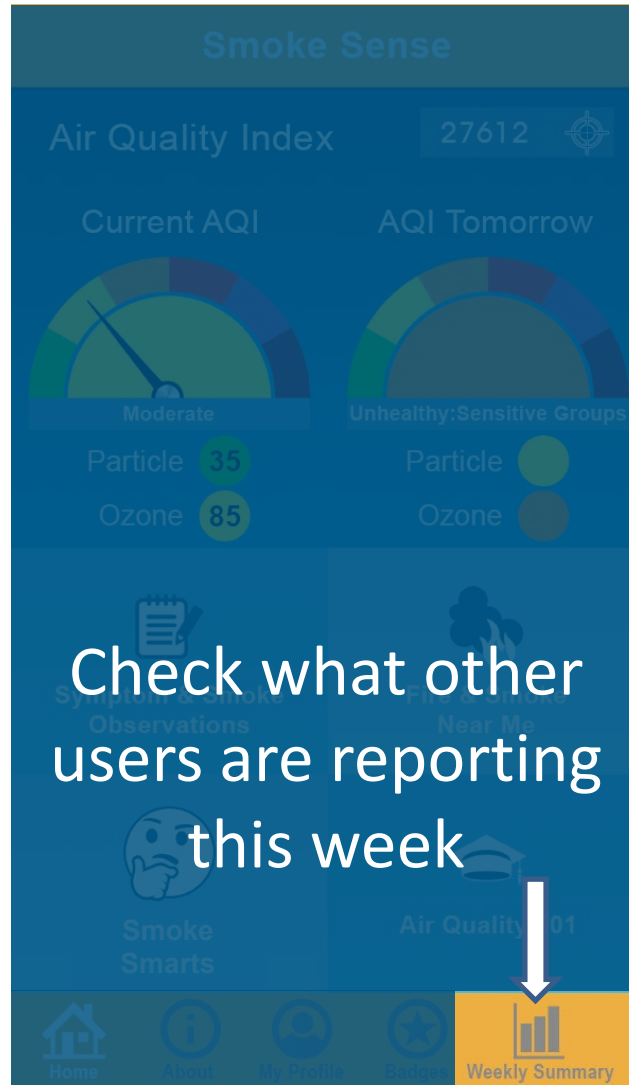
Smoke Smarts

Air Quality 101

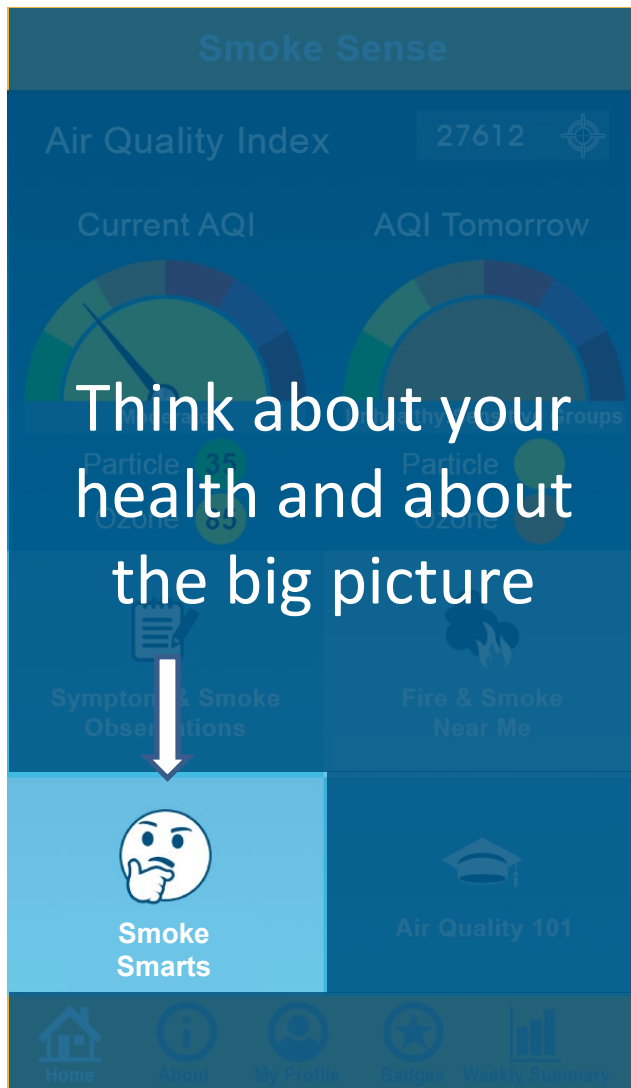
Home About My Profile Badges Weekly Summary

Back Health Symptoms

- Ear or other viral infections
- Scratchy throat
- Runny or stuffy nose
- Irritated sinuses, congestion
- Coughing, trouble breathing normally, shortness of breath
- Wheezing
- Asthma attack
- Tiredness, dizziness, or similar



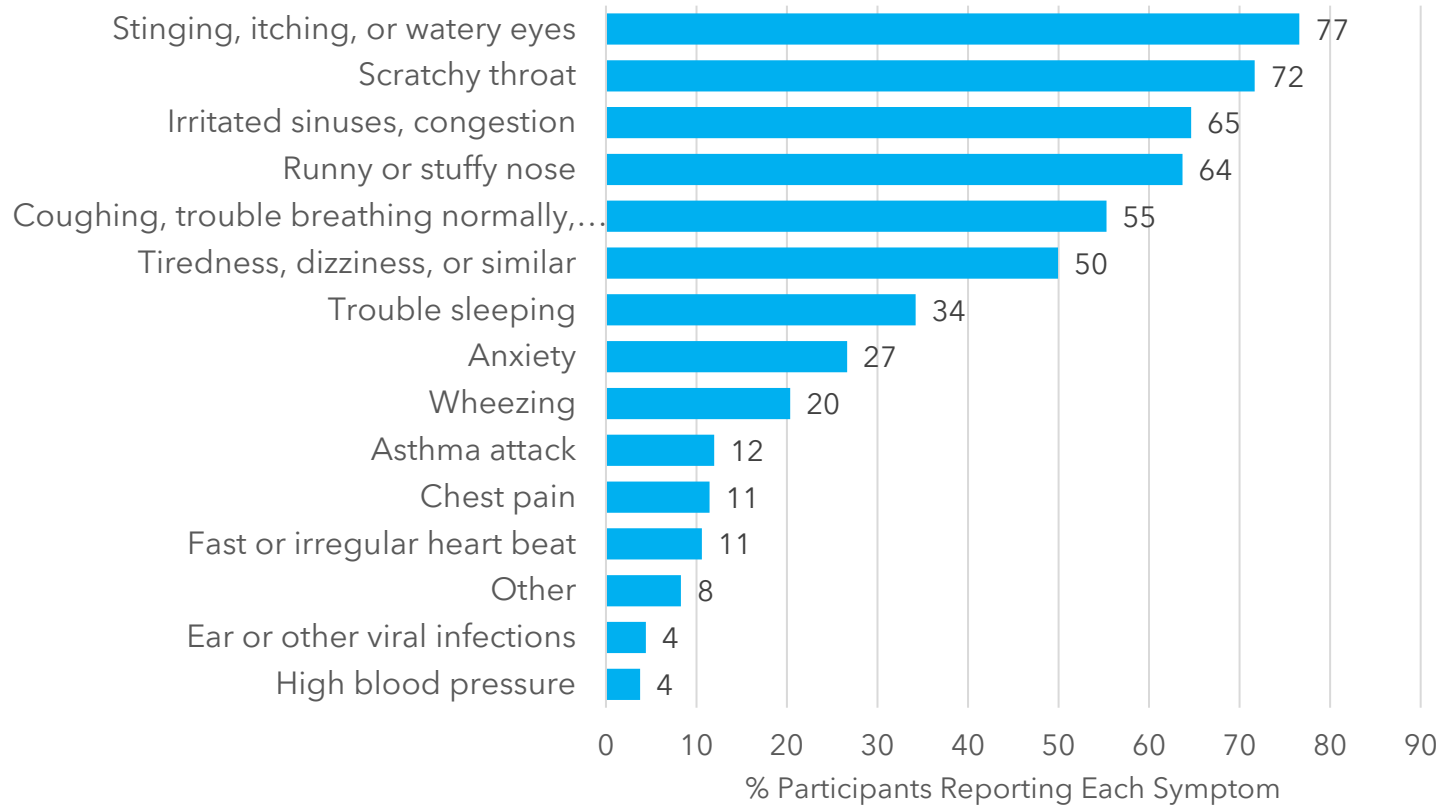
An online data playground will further enable the public to visualize and interact with data



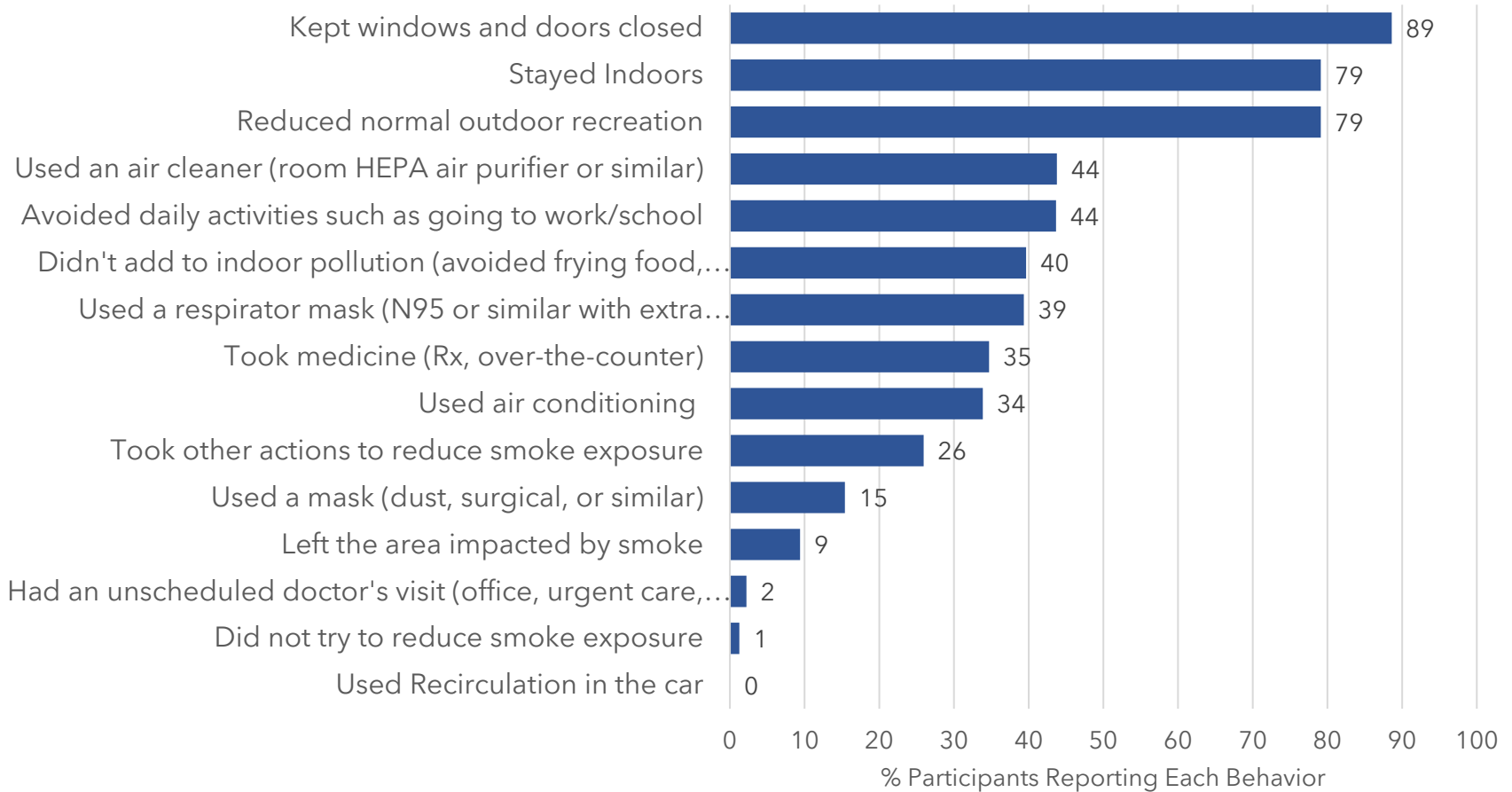
Smoke Sense: Citizen Science meets social science

- Who uses the app? Age, gender, education, race/ethnicity
- What health profile do they fit? General health, specific issues
- How do they relate to the threat of wildfire smoke?
- Is it a serious concern? Do they need more information?
- Do they have tools and techniques to reduce smoke exposure?
- What happens (closer to real-time) when smoke hits?
- What actions do people take? When & why?
- Which actions are considered worthwhile?
- What are the barriers to taking action?

Symptoms Reported



Actions Taken

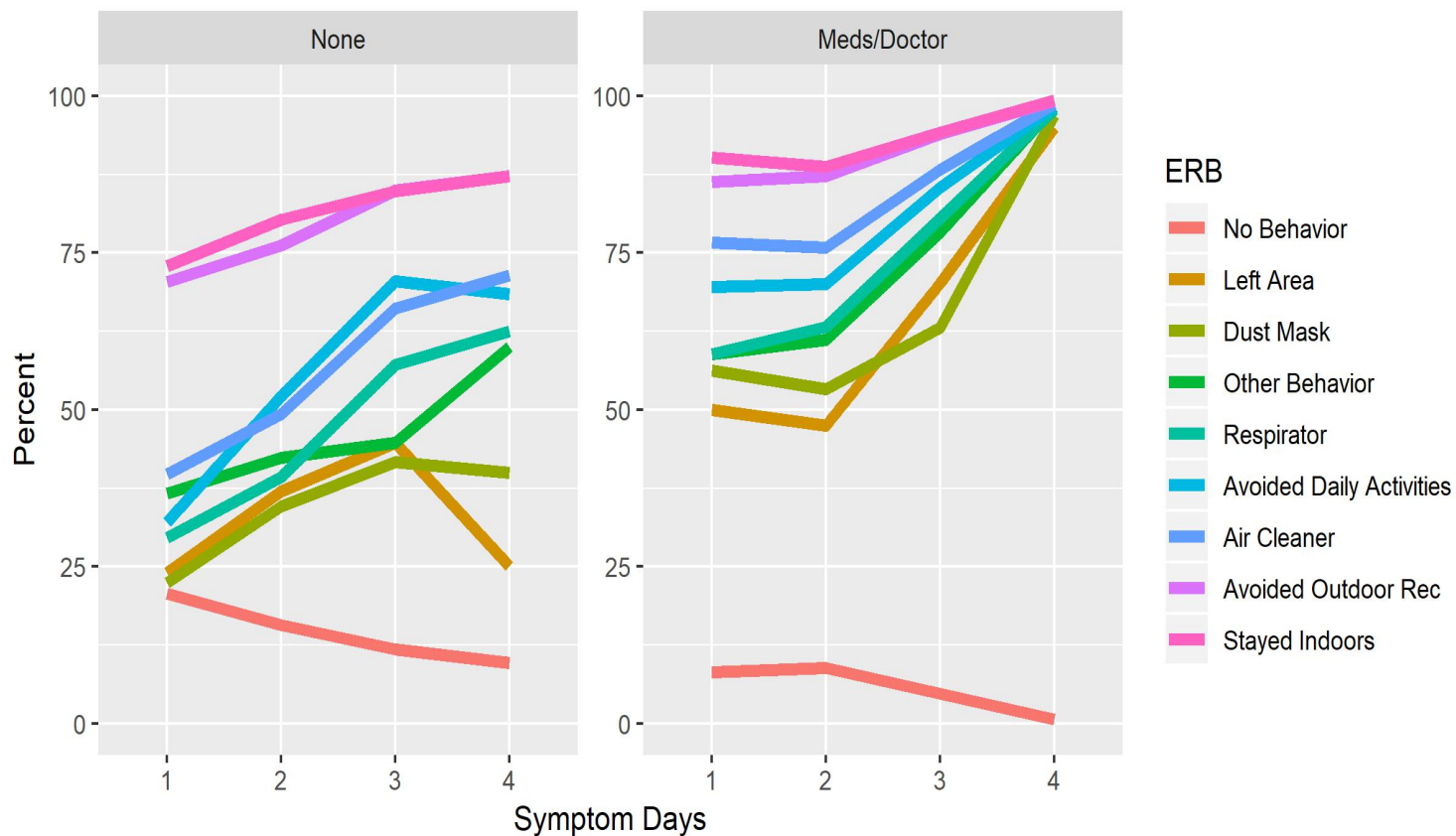


Findings from participant submitted data during the pilot season

- Very strong demand for understanding air quality during wildfires
- Spatial and temporal distribution of available air quality data does not meet user's demand
- Participants clearly recognized smoke as an exposure and as a health risk, and majority (89%) responded to smoke by taking action to reduce exposure
- *Participants recognize smoke as a **health risk** but to much lower extent a **personal risk (above average bias)***
- Health was the reason they participated, but health status did not determine how they responded to smoke
- Largely, people respond to reduce symptoms rather than prevent symptoms

Rappold, A. G., et al. (2019). GeoHealth.

Symptoms and Actions

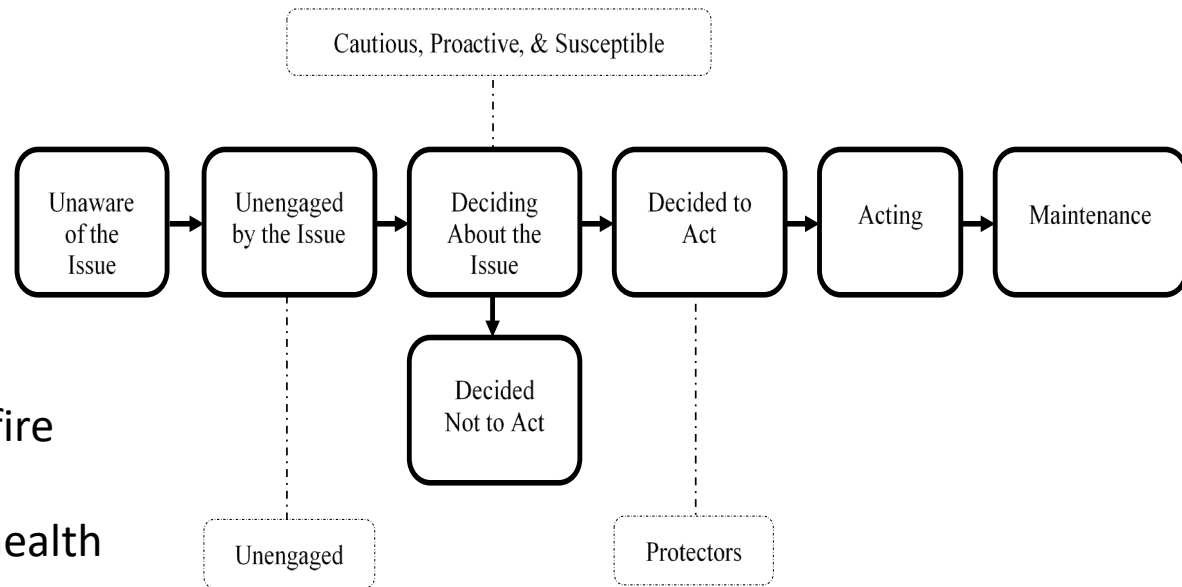


The likelihood of actions was mediated by Mitigating Behaviors/ Severity of the symptoms

Do individuals tend to share a global perspective on the issue of wildfire smoke and health, or is there heterogeneity of perspectives?

Perspectives were determined based on the responses to questions including:

- Personal health assessment
- Access to exposure reducing resources
- Previous experiences with wildfire smoke
- Perceptions about smoke as a health risk
- Self-efficacy for reducing their exposure
- Perceptions about the usefulness of information alerts
- Information needs about smoke



Hano MC, et al. (2020) *Knowing Your Audience: A Typology of Smoke Sense Participants to Inform Wildfire Smoke Health Risk Communication*. *Front. Public Health* 8:143. doi: 10.3389/fpubh.2020.00143

Perspective Traits According to the Precaution Adoption Process Model (Prochaska, et al, 2015)

Do these perspectives map to existing theories of individual-level health behavior change?

- Individuals who are at greatest risk (and who may need the messaging the most) engage with 2-way interactive features more than others
- The emphasis of that messaging may vary depending on perspectives on the issue (rather than by demographics)

	Protector	Cautious	Proactive	Susceptible	Unengaged
Propositions for Health Risk Messaging	Underscore self-efficacy for reducing exposure and nudge toward action	Link exposure with subclinical outcomes	Emphasize exposure as risk to maintaining well-being	Contextualize exposure as a modifiable risk	Underscore impact of smoke on health and activities

Smoke Smarts: Message Efficacy, Social Norms, Thinking About Behavior

- **Personalized messages vs. generic messages**

David has a long commute into the city. In the past when he drove through wildfire smoke he experienced headaches. Now, he regularly uses recirculate the air and avoids the headache during his commute.

VS.

To protect your health when driving during a wildfire, keep windows closed with air conditioning set to recirculate.

- **What is persuasive for behavior change?**
 - Advertising, reducing barriers, creating a new default option

Smoke Smarts findings

- 90% agree that ***we should***: talk to health care professionals, use HEPA filters, wear respirator masks (before Covid), heed AQ warnings, reduce indoor air pollution, use recirculate in the car, close windows and reduce outdoor exposure
- Even ***higher agreement*** when asked should vulnerable groups do so (those with cardiovascular problems or with asthma)
- 52% agreement that people actually ***do*** follow the advice
- How we asked the question did not play significant role

Personal Preferences and Barriers

Personal likelihood regarding heeding advice:

High likelihood: Recirculation in car, avoiding strenuous activities, keeping windows closed, asthma management.

Medium to high likelihood: HEPA, respirator mask, protective gear during clean up, AQ warning, indoor AQ, cardiovascular health

Low likelihood: Talking to a health care professional.

Barriers:

Cost: HEPA, Asthma management

Effort time: No clear winner

Forgetting: Talking with healthcare provider, respirator mask, indoor air quality, car recirc

Not enough benefit: Respirator, cardiovascular condition, AQ warnings, car recirc, avoid strenuous activity, keeping windows closed.

Gap analysis:

Low likelihood combined with forgetting → organizational change

Medium likelihood combined with not enough benefit → informational gap

Medium-high likelihood combined with cost → organizational change

High likelihood combined with not enough benefit → informational gap, reminders, habits

At the level of an individual – Health risk messages may need to provide information on:

➤ ***Personal relevance*** – focus on health factors and outcomes that individuals identify with, in addition to air quality and susceptibility, reinforce that actions are beneficial

➤ ***Compelling evidence that behavioral change is beneficial*** – increase normative learning, provide specific data and examples why taking action is beneficial.

Wildfire Smoke Science Communication Challenges

- Complex social issues like wildfire smoke and public health are inherently difficult to reduce into succinct, actionable, and accessible messages
- Risk of individual exposure to wildfire smoke can be tough to assess
- An individual's awareness of and perceptions about the issue influences their actions
- Risk communication platforms are evolving, and we need to know more about individual level motivations so that we can tailor content and context of messaging
- App-based communication platforms have an opportunity to incorporate messaging for a wide range of audiences
- However, a lot of questions remain regarding how to achieve the most effective communications
- Through citizen science and other participatory research, we can gain many insights on the issue.

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